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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS
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BUREAU OF TOPOGRAPHIC AND GEOLOGICAL SURVEY
GEORGE H. ASHLEY, STATE GEOLOGIST

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By
J. French Robinson

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INTRODUCTION

For many years Pennsylvania has been a large producer of natural gas. Allegheny County has produced considerable gas but not until August, 1919, did the McKeesport Gas Pool come into very great prominence. The McKeesport Gas Pool is located in Allegheny County near the city of McKeesport, 15 miles southeast of Pittsburgh at the junction of the Youghiogheny River with the Monongahela.

The Bureau of Topographic and Geological Survey is receiving many inquiries relative to the production of this pool and therefore it has been deemed advisable to issue a bulletin giving the production to date. A detailed study of the field has been made, and a historical report will be published later.

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STRUCTURAL LOCATION

The term "McKeesport Gas Pool" is very vague, but in this report it is considered to include all the territory on both flanks and top of the southwestern extension of the Murrysville anticline in Versailles township, and portions of Portvue, Lincoln and Elizabeth townships. The intense drilling, however, has not spread over 500 acres and has been in the neighborhood of Versailles, Snake Hollow, and Five Fields. Development has now extended in all directions, towards the Bellevernon anticline on the southeast, the Pin Hook anticline on the northwest, and for many miles in either direction along the Murrysville anticline.

DEVELOPMENT

The McKeesport Gas Pool became a commercial pool on August 29, 1919, when the "big gusher", (the Foster and Brendle-Hamilton #3 well,) was turned into the Peoples Natural Gas Company's mains. This well was "drilled in" on August 23, 1919.

Very little time was lost and very little gas wasted in getting the wells connected to a distributing company's lines as several such pipe lines passed through or nearby the pool.

Most of the wells in the McKeesport pool obtained their gas from the Speechley sand, although some obtained a good supply of gas from the Murrysville, some from the One Hundred Foot and some from the Elizabeth sands. The Speechley sand lies about 3270 feet below the Pittsburgh coal and has an average thickness

of 30 feet; the Elizabeth sand lies 2530 feet below the coal and has an average thickness of 20 feet; the One Hundred Foot sand is 1955 feet below the coal and has an average thickness of 80 feet; the Murrysville sand lies 1850 feet below the coal and has a thickness of 90 feet.

Most of the wells in the McKeesport pool started drilling a few hundred feet below the Pittsburgh coal horizon, depending upon whether they were located on the hills or in the valleys. Several wells have been drilled to the Bradford sand but no gas was obtained.

PRODUCTION

The daily production, total production, number of producing and dry wells, "closed-in" pressure, and average pipe line pressure are shown graphically on the accompanying chart. The daily and total production of the Foster and Brendle-Hamilton #3 well is also shown on this chart.

To those not familiar with the use of graphic charts the following explanation will be helpful: from the attached chart one can observe the daily production for any day desired from August 29, 1919, to December 31, 1920. For example, November 10, 1919, gives the peak or "big day" production for the pool, namely 71,530,000 cubic feet of gas. Just above the daily production curve is shown the graph of the number of producing wells. On that day the number was five. The average daily production per well at this time was 14,306,000 cubic feet of gas. On the total production curve at November 10 is given

the amount of gas the field has produced to that time, namely 3,725,939,000 cubic feet. The pressure curves for the same date show the "closed in" pressure to be 900 pounds per square inch, and the average line pressure to be 250 pounds per square inch. The daily production of the "big" well can be read in the same manner as the daily production of the field and is 42,772,000 cubic feet; its total production to November 10, 1919 was 3,336,423,000 cubic feet of gas. In like manner the behavior of the whole field can be had for any day during the sixteen producing months.

On May 1, 1920, the daily production from 90 wells was 32,900,000 cubic feet of gas, and the total production to that date was 12,792,100,000 cubic feet with 110 dry wells in the field. The "closed in" pressure was 130 pounds per square inch while the average line pressure was about 25 pounds. The daily production of the Foster and Brendle-Hamilton #3 well was nothing, as the well was being cleaned out. Total production of this well to May 1st was 5,708,137,000 cubic feet. Hence to May 1 the "big" well produced 44.6% of all gas produced from the pool.

As one observes the chart closely it can be seen that a well or group of wells being turned in has a noticeable effect on the rise and fall of the daily production curve. The production from November, 1919, remained more or less constant, declining slightly until February 1, 1920. At that time twenty-eight wells were producing instead of five as on November 10, 1919. The daily production on February 1, 1920 was 64,000,000

cubic feet of gas or an average of 2,400,000 cubic feet per well. The total yield of gas from the pool to February 1, 1920 was 9,009,300,000 cubic feet. From February 1 to June 1 the decline in production was very noticeable even though the number of completed wells was increasing rapidly. The daily production on May 31, from 117 wells was 19,400,000 cubic feet of gas or 170,000 cubic feet per well. There were 294 wells completed to the Speechley sand in the McKeesport gas pool to May 31, 1920, one hundred and seventy-seven (177) of this number failing to produce paying quantities of gas. From the period May first to fifteenth, fifty-four wells were completed to the Speechley sand, and of this number fourteen produced gas.

August 29, 1920 was the first birthday of the McKeesport gas pool. On that day there were 167 producing wells, and a total of 528 known wells completed to the Speechley sand. The daily production from the 167 wells was 17,000,000 cubic feet or an average of 101,800 cubic feet for each producing well. The pool registered during the first year 15,255,100,000 cubic feet of gas. Foster & Brendle-Hamilton #3 well produced the first year 5,720,521,000 cubic feet of gas or a little more than one third of the total production.

On September 30, 1920, one hundred and eighty-five (185) wells were producing 12,600,000 cubic feet of gas per day or 68,000 cubic feet per well. The total production to this time was 15,756,100,000 cubic feet of gas. To this date 382 wells have been recorded as dry or having ceased to produce gas. Of the original producers 53 wells had been exhausted. About 400 wells

were either drilling, abandoned, or locations abandoned. All in all, this makes in the neighborhood of 1,000 wells for the McKeesport Gas Pool. On November 30, 1920, four hundred and nineteen (419) wells had been plugged and one hundred and seventy-seven (177) wells were producing 9,618,000 cubic feet of gas a day with a total production to that date of 16,444,444,000 cubic feet of gas. On this same date the Foster and Brendle-Hamilton #3 well was producing 34,000 cubic feet of gas daily with a total production of 5,723,771,000 cubic feet. This well has produced 34.8% of all the gas produced in the pool.

At the close of the year 1920 there were 180 wells still producing gas in the pool with 441 wells dry. The production for the month of December was 293,211,000 cubic feet or an average of 9,460,000 cubic feet daily. The total production from the pool to December 31, 1920 was 16,737,650,000 cubic feet. The "Big" well has produced 5,724,638,000 cubic feet or 34.1% of the total.

It may be of interest to compare this curve with the statement made by the State Geologist in his press bulletin of December 29, 1919. "If this reduction (of rock pressure) continues, and the number of wells now being drilled would seem to insure its continuance, it can readily be calculated how long the pressure will be sufficient to drive the gas into the pipe line. Indeed were that reduction to continue to the end, it would indicate the total life of the field to be nine months. As a matter of fact, as the output of the field decreases with the decrease of pressure, the curve of production tends to flatten

out, particularly after the installation of the pumps, so that it may be between one and two years and possibly a little longer before the field is abandoned." In the later more detailed report, dated January 12, 1920, the State Geologist said, "It is estimated that the Long Run Pool (McKeesport Pool) did not contain at the beginning over 15 to 20 billion cubic feet of gas."

In 1906, Pennsylvania reached its maximum yearly production of natural gas which was 138 billion cubic feet. In 1913 the yearly production was 123 billion cubic feet.

West Virginia's maximum yearly production of natural gas was reached in 1917 and was 308 billion cubic feet, which declined during the year 1918 to 265 billion cubic feet.

The McKeesport Gas Pool in the year from August 29, 1919, to August 29, 1920, produced 15,255,100,000 cubic feet of gas or 11% as much gas as the big year for Pennsylvania and nearly 5% as much gas as West Virginia produced in 1917.

The decline in pressure of "closed in" wells and in pipe line pressures is as follows: (Pounds per square inch)

Average Well Pressures and Line Pressures - McKeesport Gas Pool

Date	Well Pressure in lbs. per sq.in.	Line Pressure in lbs. per sq.in. Inches vacuum
August 28, 1919	1400	340
September 30, 1919	1165	300
October 31, 1919	950	260
November 30; 1919	740	222
December 31, 1919	535	182
January 31, 1920	320	139
February 29, 1920	244	102
March 31; 1920	185	63
April 30, 1920	133	25
May 31, 1920	105	14
June 30; 1920	90	10
July 31, 1920	80	10
August 31, 1920	60	10 lbs. to Vacuum
September 30, 1920	50	8 " to 4" Vacuum
October 31, 1920	40	5 " to 5" "
November 30; 1920	20	3 " to 8" "
December 31, 1920	10	1 " to 11" "

The following table gives a good idea of the behavior of the pool from time to time.

Summarized Data - McKeesport Gas Pool

Date	Producing Wells	(Reported) Initial Production	Daily Production as of date cu. ft.	% Initial	Average daily Production per well
8-31-19	1	50;000;000	31;200;000	62.4	31;200;000
9-30-19	2	62;000;000	54;919;000	88.4	27;460;000
10-31-19	4	71;500;000	65;244;000	91.2	16;311;000
11-30-19	8	142;900;000	70;364;000	49.2	8;800;000
12-31-19	12	157;042;000	64;529;000	41.0	5;377;000
1-31-20	28	260;542;000	64;500;000	24.7	2;300;000
2-29-20	38	312;542;000	46;200;000	14.7	1,216;000
3-31-20	59	432;312;000	45;200;000	10.5	768;000
4-30-20	89	612;624;000	28;700;000	4.7	323;000
5-31-20	117	734;565;000	19;400;000	2.6	165;600
6-30-20	142	814;615;000	20;200;000	2.5	141;900
7-31-20	155	841,929;000	18;000;000	2.1	116;000
8-31-20	166	871;886;000	16;000;000	1.8	96;400
9-30-20	185	879;586;000	12,600;000	1.4	68;200
10-31-20	184	879;936;000	11;600;000	1.3	65;100
11-30-20	177	880;936;000	9;618;000	1.1	54;200
12-31-20	180	881,000,000	9,190,000	1.0	51,000

PRESSURE AND FLOW.

The rock pressure and the open flow are the two common factors in determining the capacity of gas wells. The term "rock pressure" is used to designate the pressure under which the gas occurs in the sand. It is measured in pounds per square inch by means of a gauge attached to the well and read when the pressure has attained a maximum after the well has been closed for 48 hours or longer. The "open flow" of the well is the volume of gas delivered against atmospheric pressure in a given length of time. It is determined by measuring the pressure or velocity of the gas, from which the volume may be computed.

The volume of gas delivered by a well under a given "open flow" pressure depends partly on each of three factors: the diameter of the casing, the depth of well, and the porosity and thickness of the sand. Since in the McKeesport pool the size of casing and depth of the wells were nearly all the same, much of the difference in the flow of neighboring wells may be ascribed to difference in porosity of the sands from which they draw their supply. The rock pressure, on the other hand, is not affected by minor variations in the porosity of the sand, and the whole body of gas in a pool of moderate size is theoretically under about the same rock pressure.

If two neighboring gas wells, one producing a large volume and the other a small volume of gas are closed, the rock pressure registered by both will be about the same, but the larger well will register this pressure almost immediately, whereas the smaller one may remain closed for some time before its pressure

reaches the same figure. Therefore, a high rock pressure does not necessarily mean a high flow, but on the other hand a high flow is usually accompanied by a high rock pressure, and the open flow and pressure decline at about the same rate.

The flow of a well is greatly influenced by local conditions, such as the porosity of the sand, thickness, etc., but the pressure decline in a small pool is a very accurate index of the stage of exhaustion of its reservoir of gas.

EFFECT OF PUMPS ON PRODUCTION

About June 12, 1920 the Peoples Natural Gas Company began operating their pump station on the McKeesport Gas Pool. By means of the pumps the pressure at the wells was lowered and lowered until at the present time the pumps have reached an eleven inch vacuum. The pumps did not increase the daily production noticeably but did check the decrease and since then the decline has been very slow and gradual. (See production curve)

The Manufacturers Light and Heat Company put their pumps into operation on September 15, 1920. at which time a little increase in daily production was recorded but the production is still on its downward course. They are operating on about an eight inch vacuum.

It must be remembered that with the pumps operating, the volume of gas produced from time to time is a poor index as to the actual life of the pool. Notice the curve for the past three months - the decline in production is very small, but on the other hand the effect of the pumps have created a vacuum from about zero to eleven inches. No doubt the production will

remain more or less constant as the vacuum is increased, but of course this cannot go on indefinitely.

The writer estimates that the commercial life of the pool will end about June 1, 1921, and the total production of gas will be 18,000,000,000 cubic feet. The total production of the Foster and Brendle-Hamilton #3 well will be about 5,730,000,000 cubic ft. ("Big" well will have produced 31.8% of all the gas.) Using these figures the percentage of exhaustion of the well and percentage of depletion of the pool follows:

Percentage of Exhaustion at End of Each Month.

	Foster & Brendle-Hamilton #3 Well	Pool
3 days of August & September 1919	24.77%	8%
October	51.51	17.0
November	72.83	28.3
December	88.57	39.0
January 1920	96.04	50.0
February	98.73	58.7
March	99.54	65.8
April	99.62	71.
May	99.73	75.3
June	99.77	78.6
July	99.80	82.
August	99.83	85.2
September	99.86	87.5
October	99.88	89.7
November	99.89	91.4
December	99.90	93.0

Again, the average flow from the Foster and Brendle-Hamilton #3 well for the first month was 24% of the initial flow of the first day of that month, while the flow for the pool was 24.3% for the same time. In a comparison of the registered flow of the Foster and Brendle-Hamilton #3 well for each month with the first month (September 1919) as well as that of the total

pool, the following result was obtained:

Comparison of Flow for Each Month with September (1919)

		Foster & Brendle-Hamilton #3	Total
October	- 1919	111.5%	121.2%
November		91.9	150.0
December		67.1	143.1
January	1920	33.0	148.7
February		11.62	111.3
March		3.46	96.3
April		.34	69.4
May		.49	57.3
June		.18	44.7
July		.15	45.4
August		.12	41.5
September		.09	33.4
October		.08	29.2
November		.06	21.9
December		.07	21.8

In making use of the above figures it must be remembered that many wells were being completed each month which not only affected the total production of the pool, but had a direct bearing on the production of the Foster and Brendle-Hamilton #3 well. It must also be remembered that during the first month's flow of the "Big" well, some gas escaped into the air, the pipe line not being sufficient to care for the total discharge.

ACKNOWLEDGEMENTS

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Elizabeth B. Garner
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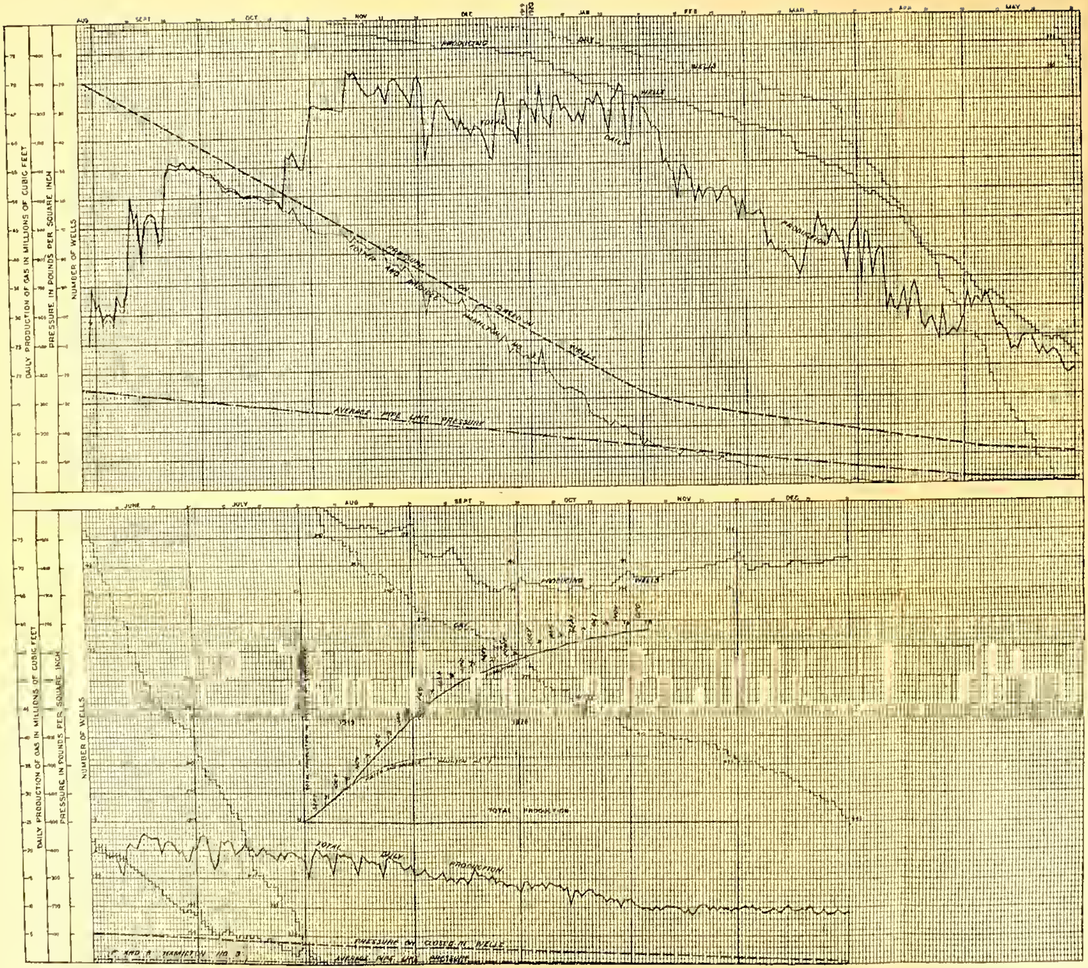
DATA RELATIVE TO THE McKEESPORT GAS POOL

BY J. FRENCH ROBINSON

O. P. SOLEM, CHIEF DRAUGHTSMAN


AUG
SEPT
OCT
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1919
1920
JAN
FEB
MAR
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MAY
PRODUCING GAS WELLS
TOTAL DAILY PRODUCTION
PRESSURE ON CLOSED-IN WELLS
FOSTER AND MADGE HAMILTON NO. 3
AVERAGE PIPE LINE PRESSURE
DAILY PRODUCTION OF GAS IN MILLIONS OF CUBIC FEET
PRESSURE IN POUNDS PER SQUARE INCH
NUMBER OF WELLS
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
PRODUCING GAS WELLS
1919
1920
TOTAL PRODUCTION
TOTAL DAILY PRODUCTION
PRESSURE ON CLOSED-IN WELLS
F. AND M. HAMILTON NO. 3
AVERAGE PIPE LINE PRESSURE
DAILY PRODUCTION OF GAS IN MILLIONS OF CUBIC FEET
PRESSURE IN POUNDS PER SQUARE INCH
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